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AGROFORESTRY: A COMPLEX SYSTEM FOR RESOURCE-POOR FARMERS

by

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ABSTRACT

Agroforestry has potential as a technology for resource-poor farmers. Like modern high-yield intercropping systems, agroforestry has several characteristics of interest: (1) complexity, (2) productivity, (3) risk; and (4) investment. Each characteristic has potential advantages and disadvantages for the poor which can be manipulated and improved with applied research.

Key Words : agroforestry, rural poverty, productivity, small farmers.

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INTRODUCTION

A number of definitions of agroforestry have been offered in recent years (e.g. King 1979; Khosla 1982, Raintree 1983). The conception used here is broad, and includes any farm situation where tree crops, annual crops and/or animals interact significantly over time or space. The trees may be grown for fuelwood, timber, fodder, fruit or other non-wood forest products. Included are conventional intercropping and alley cropping patterns as well as tree crops adjacent to annual crops or along edges on bunds and the like. The interactions include competition between trees and crops for light and moisture and the ameliorating effects of wind or shade protection for crops or animals. The key characteristics of trees in a farm context are (1) their perennial nature and (2) their height and/or root depth vis-a-vis other crops.

The Ford Foundation's concern with agroforestry has focused on resource-poor farmers because much of the Green Revolution by-passed this group. Although not a common indigenous system throughout the nation, improved agroforestry systems appear to have potential advantages for the rural poor of India.

CHARACTERISTICS

Agroforestry as a general system has several characteristics that can be contrasted with other land-use alternatives facing poor farmers: (1) complexity, (2) productivity, (3) risks and (4) investment. Each of these characteristics suggests potential advantages and disadvantages for resource-poor clients.

Agriculture and forestry are inherently more complex production systems than the typical industrial plant. This seldom is appreciated by engineers, business people or planners, but it is a dominant reason why virtually worldwide neither large collective nor corporate farms have been as efficient as small private ownerships. Agroforestry further increases complexity. To take on increased difficulties, farmers must feel confident that they will receive increased net benefits, reduced risks or both from agroforestry.

Intercropping, which is a scientific refinement of an indigenous system, often yields more biomass per hectare (Willey 1979a, 1979b). Differences between crop needs for light and moisture, coupled with the longer effective growing season for perennials, virtually guarantee that this will be true in agroforestry. Whether the additional biomass will have more value than the tradeoff paid in reduced crop yields is conjectural. Cereal grains and pulses are quite valuable per unit, and most tree products are not. It is possible, however, in some cases of intercropping for perennial fodder or small fuelwood with

nitrogen-fixing trees that there will be no crop reduction.^{1/} Unless the total value is greater, however, increased complexity will not be justified.

Risks can be reduced by agroforestry systems. Crop failure and risks from weather, especially drought, are reduced in most intercropping systems, and trees generally are more drought resistant than annual crops. Many resource-poor farmers face with virtual certainty that basic soil productivity is declining over time. Soil erosion, exhaustion of nutrients, decline in organic matter, and poor rainwater percolation are among the reasons for this decline. Where productivity declines are a certainty, agroforestry as a conservation system provides the equivalent of a gain just by preventing future declines. Productivity rehabilitation, which is likely, is another gain.

Farmers face social as well as biophysical risks. Illness, unexpected off-farm work opportunities or obligations, and the vagaries of seasonal labor demands mean more flexible crops, like fuelwood, timber and many non-wood forest products, have a risk-reducing value. Financial crises can be met by liquidating some tree capital in most seasons and most years. Because trees are divisible, cheap to replace and currently increasing in real value from both price increases and biological growth, they can serve a buffering role in the resource-poor family.

^{1/} For thorough discussions of forest and tree crop biological productivity, see Cannell (1983) and Hibbs (1984).

Market risks affect all crops, and diversification is a common method to reduce total risk. The risks of forest crops relative to cereals, legumes, milk and other farm produce is not known at this time, but they are not likely to be highly correlated. Fuelwood demand is steady and growing, but excess supply and low prices are possibilities that cannot be ruled out for the future. Industrial wood markets fluctuate with local and macro-economic activity. Fruits and other food products are more affected by supply fluctuations than demand, while demand for industrial and luxury goods (e.g. lac, tasar silk) generally fluctuate with business cycles.

One additional risk that may rapidly become a certainty is lack of access to common property or common-access resources. Many resource-poor farmers, especially tribal people, are dependent on common-access forest and pasture lands for fuelwood, fodder or grazing and a variety of non-wood (minor) forest products (e.g. Jodha, 1983). The rate of productivity degradation is high on these lands, and many are already in wasteland status.^{2/} Population growth, reallocation of common lands, and continued degradation virtually guarantees less access to the products of common property and common-access lands. Agroforestry is a many for producing most of these products on private lands.

^{2/} Agarwal et al. (1982) estimate over 175 million hectares (66%) of India's 266 million hectares of cultivated and non-cultivated area is degraded. There are some estimates that perhaps 40% of this area is in wasteland status where hectares produce 20% or less of potential dry-weight biomass output.

A farm is an investment. The soil and whatever outbuildings, canals, terraces, etc. that are added produce income flows to the farm family over time. Maintenance of the investment keeps the income flows up; low reinvestment leads to declines in income over time. Trees and some animals share the traits of investments - income today is foregone to earn more income tomorrow. It is this characteristic that is most likely to inhibit resource-poor farmers from taking up agroforestry. Investment funds are not available, subsistence food stuffs cannot be given up for space to grow trees, and waiting for trees to mature financially is very expensive in a cash-poor family.

The increased availability of credit for poor farmers and the rapid rise of real wood prices are possible counter balances. When credit is the limiting factor, which is virtually always true with the rural poor, internal rates of return are dominated by consumption needs for survival and external rates of interest are set by money lenders. Credit for worthwhile investment breaks the chain of strategies based on high consumption time preferences and exploitation. Indian timber prices increased an average 5.8% compounded annually 1970-80 in real terms.^{3/} Coupled with annual biological growth rates of 6-10% and some quality improvement with size (i.e. $Rs./M = f(M)$ /linear M of log), real returns from forestry or agroforestry could be 12 to over 20%. This is substantially above the real cost of credit.

^{3/} This preliminary estimate was made using GOI data indexed by Warner (1982) for wholesale price and timber price indices, deflating timber prices, and estimating the B coefficient in $\text{Log (Real Price 1980) = B Log (Real Price 1970)}$.

SMALL FARMER ADVANTAGES

Each of these characteristics affects both large, relatively richer farmers and small, resource-poor farmers.^{4/} What are the likely differential effects?

Complexity, interestingly enough, favors the smaller operator. Large farms and plantations worldwide are based on sophisticated simplicity: e.g., high-yield varieties; control over water, nutrients, and pests; mechanization and high capital intensity; participation in national or international markets; ready access to capital. Similarities among timber, tea, rubber, and cocoa plantations world-wide are striking. While sophisticated and often with high-technology inputs, the basic cropping systems, like all industrial activities, are simple. Management is more a matter of goals and controls than constant decision making or reexamining basic strategies. Many traditional farmers are reluctant to try innovations because the perceived risks are high if subsistence food production is threatened. However, they are used to complexity and decisions in most of their traditional systems. With some exceptions, new agroforestry technologies are not likely to appeal to the larger farmer where simplicity is one of the prices he has paid to manage the scale of his operations.

If more net biomass can be produced by agroforestry, it will benefit big as well as small landowners. The total package, however,

^{4/} Resource-poor farmers are defined here to be less than 1 hectare on good soil with or without irrigation; also includes marginal farmers on larger tracts of poorer soil.

may have more internal value to the small farmer than the large. Presuming no scale economies in production, the small farmer often is at a comparative disadvantage because he does not participate fully (if at all) in the market. Therefore self-sufficiency in food, off-season fodder, fuelwood, etc. will be of more value to him. People who sell very little can buy very little. It should be noted that this advantage for the poor, such as it is, is best done away with by full participation in the market with resultant earnings well above subsistence.

Risk is where differences between richer and poorer are most pronounced. Virtually no farmer likes risks; those that do, do not survive. The poor have two disadvantages. First, any loss is much more likely to be tragic in terms of family health or life itself. Second, there is less opportunity to diversify; to spread risks over more activities and consequently reduce the overall probability of serious losses. Insofar as agroforestry (1) increases expected outcome, (2) reduces risk of crop failure or socially-based problems, or (3) adds another dimension or two to the possible portfolio of activities, it is beneficial to the poor relatively to the rich simply because of relative vulnerability.

The investment requirements of agroforestry is the one characteristic that disfavors the resource-poor farmers. Credit, as mentioned, can alleviate this problem, but richer farmers always have an investment edge over poorer farmers. Applied forestry research can shift the balance toward the needs of the poor. For example, short-rotation (2-3 years), high plant density fuelwood and fodder

production systems will be especially useful on subsistence farms. Mixed species systems with short-term fuelwood or fodder production for home use and longer-term (5-10 year) timber production for cash may be especially attractive. Low-input systems, such as coppice or hedge cultures, are attractive to the poor.

One especially interesting research question is the strategic roles of agroforestry. In some cases, an agroforestry pattern is an appropriate target land-use system. In other cases, a sequence of agroforestry patterns represents a strategy for rehabilitating degraded soils, especially wastelands. The final target land-use system may be an agroforestry pattern, a pulse-cereal intercropping pattern, grass, or a monoculture. In some situations, where high incomes can be earned by a sustained-yield of timber and non-wood forest products, agroforestry patterns will be transitions back to forest ecosystems that tree farmers manage for cash and then purchase most of their food and other needs from the market place. This is one route away from subsistence-level poverty that should not be overlooked.

CONCLUSION

Agroforestry is not a panacea for rural poverty, nor will it make low-productivity agroclimatic regions of India as rich as the Punjab and Haryana. It is a set of land-use alternatives that, if developed with resource-poor farmers in mind, can provide increased values and reduced risks. Overall, it is likely to become a more important land-use alternative for resource-poor farmers in India.

REFERENCES

- Agarwal, A., R. Chopra and K. Sharma. 1982. The State of India's Environment 1982: a citizens' report. New Delhi, Centre for Science and Environment P.189.
- Cannell, M.G.R. 1983. Plant population and yield of tree and herbaceous crops. In Plant: P.A. Huxley (Ed.). Research and Agroforestry, Nairobi, International Council for Research in Agroforestry Pp.489-502.
- Hibbs, D.E. 1984. Forest vegetation productivity and manipulation. New Delhi, Ford Foundation, Discussion Paper (In Press).
- Jodha, N.S. 1983. Market forces and erosion of common property resources. Paper presented at International Workshop on Agricultural Markets in the Semi-Arid Tropics. Patancheru, A.P., ICRISAT, P.26.
- Khosla, P.K. 1983. Agroforestry resources in the western Himalaya. Solan, Department of Forestry, H.P. Krishi Vishva Vidyalaya P.89.
- King, K.F.S. 1979. Concepts of agroforestry. In: T. Chancellor and D. Spurgeon (Eds.). International cooperation in agroforestry. Nairobi, International Council for Research in Agroforestry, Pp.1-13.
- Raintree, J.B. 1983. A methodology for diagnosis and design of agroforestry land management systems. In: D.A. Hoekstra and F.M. Kugaro (Ed.). Agroforestry systems for small-scale farmers. Nairobi, ICRAF, Pp.8-26.
- Warner, F. 1982. Indo-Swedish forestry programme II 1982/83 to 1986/87, background document. New Delhi, Swedish Embassy, Development Corporation Office P.92.
- Willey, R.W. 1979a. Intercropping -- its importance and research needs Part 1. Competition and yield advantages. Field Crop Abstracts. 32(1):1-10.
- Willey, R.W. 1979b. Intercropping -- its importance and research needs. Part 2. Agronomy and research approaches. Field Crop Abstracts 32(2):73-85.